december, 1961

nlgi spokesman

journal of the national lubricating grease institute

President's Address—1961

Newly-Elected Officers and Directors for 1961-62

The Federal Hazardous Substances Labeling Act
By A. E. DOOLEY

The Experience of the Ordnance Corps with Greases Made from Low Viscosity Oils
By S. F. CALHOUN

Discussion of NLGI-ASTM Symposium Paper on The Experience of The Ordnance Corps with Greases Made from Low Viscosity Oils
By G. K. BROWER

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Volume XXV December, 1961 Number 9

Published Monthly by the National Lubricating Grease Institute, T. W. H. MILLER, Editor; VIRGINIA ALLEN, Assistant Editor, 4638 J. C. Nichols Parkway, Kansas City 12, Missouri. Telephone VAlentine 1-6771. 1 Year Subscription, $5.00. 1 Year Subscription (Foreign), $6.00.

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THE COVER

LIFTING the gavel to call the 29th NLGI Annual Meeting to order, C. L. Johnson opens the program at the Rice Hotel in Houston . . . the annual meeting which he had organized as vice-president and program chairman. Two days later, the board of directors elected Johnson to the presidency of the Institute, as the 29th man to head this technical association. For a story on this veteran of the lubricants business, turn to page 269. Other features in this issue include articles published from papers given in Houston last month, beginning on page 270.

The NLGI SPOKESMAN is indexed by Industrial Arts Index and Chemical Abstracts. Microfilm copies are available through University Microfilm, Ann Arbor, Mich. The NLGI assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the NLGI. Copyright 1961. National Lubricating Grease Institute.

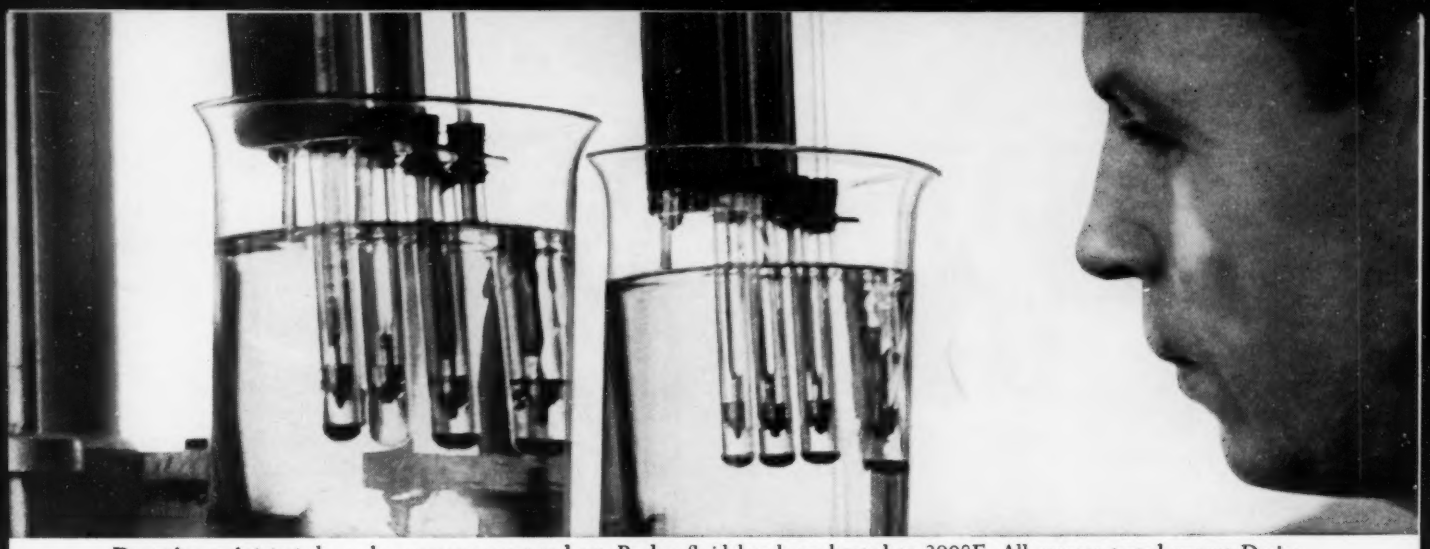
NLGI PRESIDENT'S PAGE

By C. L. JOHNSON, *President*

Season's Greetings

It is with a spirit of accomplishment and thanksgiving that we may acknowledge the Christmas celebration and the last of 1961, which ended on a positive, progressive note. It is with renewed enthusiasm and interest that we should anticipate the coming of 1962.

Our industry has proved itself to be a dynamic one in the face of a number of difficulties in the past year, and it is my sincere belief that our individual members will rise to new heights in the twelve months to come. To all of our members and friends in this country and abroad, I would like to offer very best wishes for the season, and a happy, prosperous year to come.



Dropping point test shows how greases react to heat. Beaker fluid has been heated to 390°F. All greases tested except Darina (second tube from left) have passed from solid to liquid state.

BULLETIN:

Shell reveals the remarkable new component in Darina Grease that helps it save up to 35% on grease and labor costs

Darina® Grease is made with Microgel*, the new thickening agent developed by Shell Research.

Darina lubricates effectively at temperatures 100° hotter than most conventional soap base greases can withstand.

Read how this new multi-purpose industrial grease can help solve your lubricating problems and even save you up to 35% on grease and labor costs.

THERE IS no soap in Darina Grease. No soap to melt away—wash away—or dissolve away.

Instead of soap, Darina uses Microgel—a grease component developed by Shell Research.

What Microgel does

Because of Microgel, Darina has no melting point. It won't run out of gears or bearings.

Compared with most conventional soap-base greases, Darina provides significantly greater protection under adverse service conditions.

Mix water into Darina and the grease does not soften. It shrugs off water—won't emulsify.

Resists heat

Darina will withstand operating temperatures 100° hotter than most conventional multi-purpose greases. It cuts leakage and reduces the need for special high-temperature greases.

Also, Darina resists slumping, thus forming a more effective seal against foreign matter.

Saves money

Shell Darina can reduce maintenance expenses while it protects your machinery. Savings of up to 35% on grease and labor are quite possible.

In some cases lubrication intervals have been extended to double what they were before. Less grease is consumed and less time consumed applying it.

For details, see your Shell Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

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–where 1,997 scientists are helping to provide better products for industry

News About NLGI

Thanks to Sponsors

The thanks of President-Elect C. L. Johnson went to 30 Associate members for their sponsorship of NLGI's "Mr. and Mrs. Early Bird Reception" during the first day of last month's annual meeting, in Houston. This event is fast becoming a tradition with the Institute and is credited with opening the meeting with a fine spirit of friendliness and cooperation.

30th Annual Meeting to Be Held in Chicago, 1962

The 30th Annual Meeting of NLGI will begin Sunday, October 21 and conclude Wednesday morning, October 24, 1962. The meeting place will be the Edgewater Beach hotel, Chicago.

Part of the program will deal with gear lubricants, in a joint effort with the American Gear Manufacturers Association, it was announced by T. F. Shaffer, NLGI vice-president and program chairman. Technical sessions will occupy a full day, he added.

NLGI conventions are held beginning the fourth week in October, with the one exception of 1962, when the only availability was in the third week.

New Technical Representative

Petroleos Mexicanos, Tampico, has appointed Dr. Agustin Corona M. as NLGI Technical representative for this Active member firm.

Sample Production Survey Questionnaire Out Soon

All U. S. and Canadian Active members of the Institute will receive sample mailings in mid-December, showing the type of questionnaire which will be employed on the Fifth Annual Production Survey. This regular compilation of pounds of lubricating greases and fluid gear lubricants will feature the same questionnaire as used in previous years, and the agency collecting the data will again be Ernst & Ernst, national certified public accounting firm.

Technical Committee Column

CHAIRMAN L. C. BRUNSTRUM
Senior Research Associate
Research & Development Dept.
American Oil Company
P. O. Box 431
Whiting, Ind.

Plans for several 1962 activities of the Technical Committee were finalized at the Houston meeting.

W. R. Wright, of Sun Oil Co., will serve as the co-chairman of a joint NLGI-CBBI (Cast Bronze Bearing Institute) subcommittee. A major objective will be the development of recommendations for grease lubrication of cast bronze bearings. R. L. May, of Sinclair Refining Co., will succeed George Entwistle, retiring, as chairman of the Editorial subcommittee. A new subcommittee on Permeability will be chairmanned by Walter Ewbank of Cato Oil and Grease Co. Their work will be related to oil leakage in service, a project under consideration by ASTM. C. E. Hulme, of Kendall Refining Co., has assumed the chairmanship of the subcommittee on Methods and Terms. The other 1961 chairmen will continue to serve in 1962; two will retire during the year.

Two subcommittees will organize half-day sessions for the 1962 meeting. E. L. Armstrong of Socony Mobil Oil Co. is in need of papers of a research nature. A symposium on gear lubrication will be developed by R. K. Smith of E. F. Houghton & Co. Suggestions for papers should be transmitted directly to them, preferably before the end of January.

The Consistency Projects subcommittee under M. Ehrlich recommends the addition of two semi-fluid grades to the NLGI classification. This recommendation will be submitted to the Technical Committee as a letter ballot. The effect of lubrication frequency on steering effort will be a major project for 1962. A committee under R. S. Barnett of Texaco Inc. has completed a test procedure which will soon be submitted in cooperation with the Chassis Lubrication Committee of the board of directors.

C. L. Johnson Elected 29th President of NLGI

Claude L. Johnson was elected 29th president of the National Lubricating Grease Institute, at a meeting of the Board of Directors in Houston, Texas, October 31, 1961. He is president of Jesco Lubricants company, North Kansas City, Missouri.

The new chief executive of the Institute was first elected to the Board of Directors in 1953, and has served on or acted as chairman of a number of committees. Prior to his election last month, Mr. Johnson had served NLGI as secretary and as vice president-program chairman. He is a veteran of 44 years in the industry.

Graduating from the University of Oklahoma with a BS in 1917, Mr. Johnson immediately went to work for the Marland Refining company, holding a number of jobs and rising to the position of chief chemist. In 1929 he was instrumental in forming Jesco, where he served as treasurer until 1945, when he became president. He has an excellent reputation throughout the lubricating grease field as a research and development expert who has introduced many innovations into product production.

Mr. Johnson, in addition to his interests in NLGI, belongs to the American Chemical Society, the American Society of Lubrication Engineers, the American Society for Testing and Materials and the Kansas City Oil Men's club. He is an active hunter, fisherman and gardener, and actively collects antique tools. He and Mrs. Johnson have two daughters and three grandchildren, all of Kansas City.

PRESIDENT'S ADDRESS – 1961

Remarks by the 28th President of the National Lubricating Grease Institute at the Annual Meeting, Houston, Tex.

By F. R. HART
Immediate Past President, NLGI

I AM VERY PROUD to have this opportunity of meeting with you and reporting on the Institute's business for the past year. Proud, because I am the second West Coast oil company representative to be president of the NLGI. The first Californian to receive this distinction is our very good friend, Fred Olsen of the Sunland Oil Co. Fred was president in 1954. We of the Golden West appreciate this recognition and hope that you will call on other Californians to lead you in the years ahead.

The many fine friendships my company has made with you midwest and eastern oil men have blossomed into a desire to know you better. In fact, we like you so well, we have moved into Kentucky to work closer with you. And, so it is with a true feeling of pride and pleasure that I welcome each of you to this, our 29th Annual Meeting.

Your capable program chairman—Mr. Claude Johnson—together with his able associates have worked diligently on the three-day program. I am very sure the papers to be presented will more than compensate you and your respective companies for the time you have taken from your business. On the lighter side, Mr. Ed

NLGI's 28th president, F. R. Hart, has been a veteran of the oil industry for more than 43 years, serving with Standard Oil Company of California as supervisor of marine and industrial lubricant sales for that firm. A member of the Institute's board of directors since 1955, he experienced a number of responsibilities for NLGI through various committees before being elected vice-president, and then chief executive of the Institute. The message given above is the traditional address offered by the president to the membership at the opening of the annual meeting—this year in Houston, Oct. 29-Nov. 1, concluding his year of service as head of the Institute.

NEW officers for 1962 include A. J. Daniel, treasurer; C. L. Johnson, president; and T. F. Shaffer, vice-president. Not shown is W. A. Magie, secretary, who with Johnson, was elected to the board of directors.

Campbell and his committee have arranged some attractive activities, especially for the ladies.

Your Board of Directors is very sensitive to membership likes and dislikes. Sometime ago you asked that more annual meetings be held away from centrally located Chicago. As a compromise, it has been decided that every other year (the odd years) the annual meeting will be held away from Chicago. For example, the 1959 meeting was held in New Orleans. The 1960 meeting was returned to Chicago. This year (1961) we are meeting in Houston, Texas. Looking ahead to future years, the 1963 meeting will be held in New York City, while the 1965 meeting has been scheduled for San Francisco, my home town. This means that every other year the NLGI annual meeting will convene in some city, closely connected with the petroleum industry. It also means most of us will have the opportunity of visiting and seeing the great commercial centers of this country. We hope you like this arrangement.

The year 1961 has been a year of challenge—or opportunity, depending on how you look at it. For example, the petroleum industry was confronted with a continuation of the 1960 depressed economic condition. This means the demand for product was good, *but prices were down.* All of us had hoped the changing political picture would improve business. Business *is* improving—but not at the rate expected. Labor and consumer demand problems have slowed progress. Impending government legislation, covering the labeling of petroleum products, caused some consternation. To this must be added the confusion created by certain motor car manufacturers who allegedly market grease-less type automobiles. This thumbnail review briefly summarizes the broad national problems that influenced our industry the past year.

Within NLGI, your Board of Directors was confronted with all of the problems peculiar to associations such as ours. Through the untiring efforts of our several committees, we were able to maintain a healthy position. For example: (1) Much credit goes to Mr. Frank Minor and his associates for the nine new member firms who joined NLGI this year. A strong, interested membership represents the very heart of the Institute. (2) We are also indebted to Mr. Bill Magie for the capable way in which he and his committee managed publication of the SPOKESMAN magazine. Bill originated new economies and advertising control policies to guide those who follow in his footsteps. (3) Under the guidance of Mr. Jack Lane, the Chassis Lubrication Committee crystalized an image, baptized "Otto Chekup," which is being publicized to stimulate 1000-mile passenger car safety inspections. He has worked out, with Mr. Hunt Eldridge of Chek-Chart, an annual Teknifax Bulletin, which will provide NLGI membership advance information on lubrication needs of new car models. In addition, he released several excellent brochures on effective ways to stimulate chassis grease sales; also other helpful merchandising ideas. (4) Your treasurer, Mr. Art Daniel, aided by a special committee operating under the direction of Mr. George Merkle, is making good progress in wrestling with the all-important problem of keeping overhead cost in line with income. This finance team is searching for new money and I am happy to report they are making good progress. (5) Through the efforts of the Publicity Committee, our mutual friend, Mr. Rudy Cubicciotti, has kept industry informed of the Institute's progress. (6) It is with pleasure that I briefly summarize the splendid accomplishments of the Technical Committee, under the leadership of Mr. Larry Brunstrum. Larry is a team man—a doer who thrives on progress and accomplishment. This year the Technical Committee initiated a new $3,500 Fellowship at the Northwestern University. Because of the special nature of

ELECTED to the board for three-year terms: R. Cubicciotti (Sonneborn) and E. W. Campbell (Gulf).

N. W. Williams (Pure) and F. R. Hart (Standard of California) were re-elected to the governing body.

the work to be done through this fellowship, I know Larry will want to tell you all about it later in the program. (7) To add new interest and to broaden the field of discussion, Vice-President and Program Chairman, Mr. Claude Johnson, is working with the Technical Committee in inviting outside organizations to meet with us and participate in our annual meetings. This year, a group from ASTM will join the Technical Committee in a discussion of "The Effect of Oil Viscosity on Lubricating Grease." Next year, I understand the AGMA will send members to discuss gear lubrication matters. I like co-operation—it is the heart of progress.

Unfortunately, time does not permit a more extensive review of your committee activities. Please know and believe everyone is working, and in this manner we are making headway. Over the years NLGI has gained the reputation of "getting things done." I am pleased to tell you that we have continued this effort in 1961.

We have heard much about the vanishing market for lubricating grease. Purveyors of gloom point with authority to the grease-less automobile. While it is true the automobile is undergoing some needed surgery, it is also true that it still needs and uses much lubricating grease in its operation. Not one grease manufacturer has failed in business because of this alleged shrinkage in market demand. Out west, the demand for lubricating grease is increasing! If, and when, labor difficulties stabilize and improve, I am sure the midwest, southern and eastern markets must also expand to meet the enlarged industrial requirement.

Today, the world is witnessing an exploding population. This increased population must be fed, clothed and housed, cheaply. This can best be done with machinery—machinery that produces commodities at a faster rate than we know today. New machinery is now in the making. Many prototypes are in operation! More units are on the way! Some of us do not realize the full importance of the technological changes that are taking place.

Not long ago, I visited a new can making factory, equipped with the latest high speed machinery. Each machine employed an automatic lubricator that fed a soft, semi-fluid grease from a centralized lubricant supply to the many bearings. The lubricant reservoir was sufficient for several weeks' service. When placed in full operation, this equipment produces tin cans at a faster rate than any previous machine—and does the job at a lower cost. The important point is—that only one multi-purpose, all season lubricating grease is needed. This means that product requirements are changing in the factory as well as in the automotive field.

I sometimes wonder if the lubricating grease industry is keeping pace with modern machine developments. It would seem the present and future industrial expansion provides an excellent opportunity to cooperate with machine designers and the grease dispensing people on the formulation of new and better lubricating greases. This appears to be *the* simple solution to a larger and continuing market for lubricating grease.

As I see it, to survive, our research people must prepare better products—lubricating greases possessing improved uniformity; better stability—in and out of service; inhibited greases that "stand-up" in the presence of load and temperature. In general, the market will demand better lubrication than we presently provide—and in addition, the market will also insist that this improved lubrication be accomplished with the fewest multi-purpose products. The day of complex specialized lubrication is on its way out! We no longer need 250 to 300 products to do the job—what is

TWO new board members: G. W. Miller (Battenfeld, N.Y.) and C. E. Smith, Jr. (Humble) fill vacancies.

PAST president's key given to Mr. and Mrs. Hart by H. A. Mayor, Jr. (Southwest), re-elected to the board.

needed *now* are a few good greases that may be broadly utilized to lubricate modern machinery that operates with higher bearing loads, higher temperatures for longer uninterrupted service periods. This means more quality must be built into these newer products. It also means higher prices and, I hope, improved profit.

There is nothing wrong about selling grease at a profit. Everybody knows profit is necessary in the conduct of a healthy business. The big danger occurs where a product is cheapened to increase profit. When this occurs, the entire industry is placed in jeopardy. As I see it, we can guarantee the unlimited future of the lubricating grease industry by putting more quality and more service performance into our products. In this way we encourage the use of lubricating greases rather than discourage their use.

It has been my experience that people will gladly pay a higher price for a lubricant that assures "failure-proof" lubrication. The difference in selling price rarely exceeds a few cents per pound. And so, if it's more profit you want, get it by marketing higher quality lubricants. Your cost of doing business will be less because satisfied customers rarely change suppliers.

And now to summarize:

1. Announcement of the 30,000-mile passenger car lubrication interval has stimulated the grease industry more effectively than any other event. This is as it should be as most of us are inclined to coast along in the belief that "everything is fine" and will continue to be so. We now know that this radical change in passenger car lubrication interval was based on poor service secured from weak film greases that were made to be sold at low prices. Let's not make this mistake again—to do so, may be fatal.

2. Increased product research is necessary to solve new machine lubrication problems, to reduce the number of lubricants needed and to supply the changing needs of new machinery.

3. The "Space Age" is developing a new market for lubricating greases. Rocket and missile operations call for special lubricants—possibly beyond the capabilities of petroleum products. Conceivably, these exotic lubricants will be made from chemicals or synthetics and, as such, may be developed and marketed by the chemical industry. They will always be of special interest to we people in the petroleum industry and, who knows, we may develop satisfactory lubricants.

4. To carry on and to do all the work that must be done, it is necessary that we sell improved lubricating greases at prices that net a fair profit. A healthy industry is one that makes a profit. And progress—U.S.A. style—is the goal of profit. All the fancy economic theories ever dreamed up cannot alter that one simple fact. We are what we are and where we are because free men have had the courage to invest hard-earned dollars in progress. I hope it will ever be so!

5. And lastly, I feel more confident than ever, the market for lubricating grease is expanding and will flourish for many years to come. Ours is not a dying business—it is a growing business—it is an expanding business—it is a business that changes with improved machine design. Just as long as there is machinery with reciprocating parts, that must function under loads, speed and temperature, there will be a need for lubricating grease. As I see it today, this need will be greater in the future than it has in the past.

In conclusion, more than 2,500 years ago, the ancient Greeks developed a formula for the *Good Life*. Briefly this ancient Greek formula was *nothing in excess*. Therefore, I think it wise that I now reactivate this ancient Greek philosophy by bringing this annual message to a close. Thank you! ■

FLOWERS for the ladies at the annual social hour. . . Mrs. C. L. Johnson, wife of the president-elect, receives hers.

President

C. L. JOHNSON
Jesco Lubricants Co.

Vice-President

T. F. SHAFFER
Shell Oil Company

Secretary

W. A. MAGIE
Magie Brothers Oil Co.

Treasurer

A. J. DANIEL
Battenfeld Grease and Oil Corp., Inc.

New Directors . . .

G. W. MILLER
Battenfeld Grease and Oil Corp. of New York

C. E. SMITH, JR.
Humble Oil and Refining Co.

NLGI 1961-62

C. L. Johnson has been elected 29th president of the National Lubricating Grease Institute, at NLGI's annual meeting in Houston, October 30. The president of Jesco Lubricants, North Kansas City, Missouri, Johnson had previously served as secretary and vice-president of the Institute. He has been a member of the board of directors of

Re-Elected Directors . . .

E. W. CAMPBELL
Gulf Oil Corporation

R. CUBICCIOTTI
Sonneborn Chemical & Refining Corp.

F. R. HART
Standard Oil (California)

H. A. MAYOR, JR.
Southwest Grease and Oil Co.

N. D. WILLIAMS
Pure Oil Company

Technical Committee . . .

Chairman

L. C. BRUNSTRUM
American Oil Company

Vice-Chairman

M. L. CARTER
Southwest Grease and Oil Co.

Vice-Chairman

R. S. BARNETT
Texaco Inc.

Officers and Board of Directors

the technical association since 1953.

T. F. Shaffer, manager of the industrial products department of Shell Oil company, New York, was elected vice-president, after having served last year as secretary. W. A. Magie, president of Magie Brothers Oil company, Franklin Park, Illinois, was elected secretary, succeeding Shaffer.

Treasurer of the Institute will be A. J. Daniel, who was nominated to the position for his tenth consecutive year. Daniel, a past president of NLGI, is a former president of Battenfeld Grease and Oil corporation, Kansas City. He still serves on that firm's board of directors, and has served on NLGI's board since 1945.

Directors re-elected to the board for three-year terms include Johnson and Magie, as well as E. W. Campbell, Gulf Oil, Houston; R. Cubicciotti, Sonneborn Chemical and Refining, New York; F. R. Hart, Standard Oil of California, San Francisco; H. A. Mayor, Jr., Southwest Grease & Oil, Wichita; and N. D. Williams, Pure Oil, Palatine, Illinois. Hart has just served his term as chief executive and is immediate past president.

Two new directors were elected to the governing body. They are G. W. Miller, Battenfeld Grease & Oil of New York, North Tonawanda; and C. E. Smith, Jr., Humble Oil & Refining, Houston.

NLGI's board of directors consists of 21 lubrication executives. Others serving include: Shaffer, Daniel, W. W. Albright, American Oil, Chicago; T. W. Binford, D-A Lubricant, Indianapolis; H. B. Elliott, Atlantic Refining, Philadelphia; J. W. Lane, Socony Mobil Oil, New York; G. E. Merkle, Fiske Brothers Refining, Newark; F. W. Minor, Sinclair Refining, New York; W. M. Murray, Kerr-McGee Oil Industries, Oklahoma City; G. A. Olsen, Sunland Refining, Fresno; F. E. Rosenstiehl, Texaco, New York; and W. H. Saunders, Jr., International Lubricant, New Orleans.

L. C. Brunstrum, senior research associate, American Oil, Whiting, Indiana, was appointed to his third term as chairman of NLGI's Technical Committee. This group coordinates the many technical activities of the Grease Institute, and is composed of twelve subcommittees.

Appointed to their second consecutive terms as vice-chairmen of the Technical Committee were M. L. Carter, Southwest Grease, Wichita; and R. S. Barnett, Texaco, Beacon, New York.

NLGI's governing body has always been a "working" board, with each man participating in the responsibilities of two or more committees of the Institute. The Technical Committee is built around the Technical representatives of each firm, although there is no limitation to participation, and non-member company men may join on special projects.

The Federal Hazardous Substances Labeling Act

By: A. E. Dooley, Texaco Inc.

Presented at the NLGI 29th annual meeting in Houston, October, 1961

THE FEDERAL Hazardous Substances Labeling Act is the second piece of federal legislation in this field, the first being the Federal Caustic Poison Act which was enacted more than 30 years ago. Practically all industry favored enactment of a sound federal labeling law. A labeling law at the federal level would be more desirable than a whole series of state laws and would make for uniformity. Evidence of industry's attitude can be seen in the testimony before the Senate and House Committees and in the numerous conferences with the Food and Drug Administration prior to passage of the law. As a matter of fact, I think that a large percentage of the truly hazardous household products are already labeled. The trouble has been that people do not read the labels. The principles of precautionary labeling included in the federal Act are those which were first set forth by the Manufacturing Chemists Association more than 20 years ago. They follow closely the model labeling law prepared by a group of industry associations. Industry feels that the federal Act, as adopted, was a workable statute. Industry does feel that certain of the regulations are not desirable and impose restrictions that will not further the intent of the law.

Before discussing the law, a brief chronology of events may be of interest. The law was approved on July 12, 1960 with the effective date of the penalty provisions being February 1, 1961. Enforcement and administration of the law is the responsibility of the Secretary of Health, Education and Welfare and he, in turn, has assigned the responsibility to the FDA. In the Act, the Secretary was authorized to extend the penalty date for an additional period not to exceed 12 months if conditions so warranted.

On January 31, 1961, the Secretary extended this penalty date six months to August 1, 1961 except for substances defined in the Act as extremely flammable, flammable, or highly toxic. The extension was made because the FDA was occupied in preparing regulations supplementing the Act and more precisely defining the other types of hazards. It was not until April 29, 1961, eight and one-half months after enactment of the law, that the FDA published a set of proposed regulations and invited interested persons to file comments before June 28th. These proposed regulations contained many provisions which industry felt were unrealistic, unworkable, burdensome and beyond the intent of the legislation. Then in May, the FDA published a booklet intended to be used as a guide in complying with the law and the regulations; the latter, of course, still being tentative. This booklet came as quite a shock to industry and really emphasized the unfairness and impracticality of some of the regulations. A large number of written protests were filed by industry associations, individual companies, scientists and others before the June 28th deadline. Next, the FDA scheduled a two-day open meeting on July 13th and 14th where additional protests on certain provisions in the regulations were made orally. (Those of us who serve on labeling committees of various industry associations appreciate the support and assistance of all those persons, such as Mr. Miller of NLGI, who filed written or oral comments during this period.) On July 21st, the FDA issued a further extension until February 1, 1962, the maximum permitted by the law. The regulations were issued by the FDA on August 12, 1961 in what was termed a "final order." These August 12th regulations included many changes that had been recommended by industry and I am sure they would not have been made if industry had not been so vigorous and factual in its comments. However, the regulations still contain some requirements which industry feels are entirely

too restrictive. Whether these final regulations will be modified before February 1st cannot be predicted at this time. Indications as of this date are that the FDA considers no further changes to be necessary.

The following comments, therefore, are based on the law and the existing regulations as of August 12, 1961. In the following discussion, I will comment briefly on some of the requirements that I feel are not practical or necessary.

The law regulates the inter-state distribution and sale of packages of hazardous substances intended or suitable for household use. Thus, there are two tests that must be made to determine if a given product comes under the Act.

First, is the product a hazardous substance? It is, if it can cause substantial personal injury or illness as result of customary or reasonably foreseeable handling or use, including foreseeable ingestion by children. A material is a hazardous substance under the law if it is toxic by ingestion, inhalation or absorption. It is also hazardous if it is corrosive to living tissue, flammable, capable of generating pressure, irritating to living tissue, strongly sensitizing or radioactive, as determined by tests specified in the regulations. In addition, the Secretary may declare a substance as hazardous on the basis of human experience even though it is not found to be hazardous by the various tests specified in the regulations. Incidentally, the regulations specify in detail the toxicity test methods to be used. No provisions are made for alternate and equally valid methods. In effect, the regulations have frozen the methodology. Economic poisons, food, drugs and cosmetics are not hazardous under the Act. Fuels that are stored in containers and used in the heating, cooking or refrigeration systems of a house are exempt under the Act, but the regulations do not exempt them if they have hazardous properties and are in portable containers used for delivery or temporary or additional storage.

The second factor to be determined is: is the substance in a package intended or suitable for household use? Size is not the only index. Any container—carton, bottle, bag, can, tube, or other container—of a hazardous substance is covered by the Act if, under any reasonably foreseeable condition of purchase, storage or use, it may be found in or around a dwelling. A dwelling is defined as a house, apartment or other place where people dwell and includes, but is not limited to, a garage, carport, barn or storage shed. Containers of materials for professional use, but which may be sold in retail stores such as hobby shops, are included as are items such as anti-freeze, radiator cleaners and polishes. Industrial substances taken into a home by a serviceman are exempt. Industrial materials labeled as and marketed solely for industrial use are exempt even though an employee steals some and takes it home.

Types of Hazardous Substances

1. *Extremely flammable substances* are those with flash points of 20°F or below.

2. *Flammable substances* are those with flash points above 20°F to and including 80°F.

3. *Highly toxic substances* are those with an oral LD/50 of 50 mg/kg or less; skin absorption LD/50's of 200 mg/kg or less and inhalation LD/50's of 200 ppm or less for gases and vapors or 2 mg/liter for mists or dusts. (LD/50 is the term used to indicate the quantity of a substance that will kill 50 per cent of a group of experimental animals.) These figures are the ones in general use for many years for materials classed as poisons by the Manufacturing Chemists Association and the Interstate Commerce Commission. In addition, any materials which the FDA decides on the basis of experience to merit this classification can be classed as highly toxic. In the April 29th proposed regulations, the FDA proposed to classify kerosine, ethylene glycol, diethylene glycol, carbon tetrachloride, methyl alcohol and turpentine as highly toxic. This classification would automatically require that these materials be labeled as poisons and carry the skull and crossbones symbol. As a result of industrial protests, only carbon tetrachloride and methyl alcohol have been retained under the poison category in the final regulations.

4. *Toxic substances* are those with oral LD/50's of 50 mg/kg to 5 gm/kg; skin absorption LD/50's greater than 200 mg/kg up to 2 gm/kg and an inhalation LD/50 of 200 to 20,000 ppm for gases or vapors and 2 to 200 mg/liter for mists or dusts. The regulations state that substances with oral LD/50's in the range of 500 mg/kg to 5 gm/kg will be considered for possible exemption on the basis of such factors as physical nature, size of the container, closure on the container, human experience, or other relevant factors. Industry feels that the 5 gm/kg limit is too high and is not substantiated by experience. Industry has urged and intends to continue to urge that the upper limit be set at 1 gm/kg or, at the most, 2 gm/kg and that the FDA use the authority given in the Act to declare a substance as hazardous on the basis of reliable information regardless of the LD/50. This has already been done for example with kerosine and ethylene glycol, both of which have oral LD/50's greater than 5 gm/kg. Retention of the 5 gram rule will almost surely result in a large number of separate petitions for exemption that will have to be acted on by the FDA. How long the waiting period for a ruling will be cannot be predicted but it would seem that, in some cases, considerable time will be required.

5. *Substances with special hazards*: Substances put in this category by the Commissioner to date are as follows:

a. Carbon tetrachloride in any concentration.

b. Methyl alcohol—4 per cent or more.
c. Diethylene glycol—10 per cent or more.
d. Ethylene glycol—10 per cent or more.
e. Turpentine—10 per cent or more.
f. Petroleum distillates and products containing 10 per cent or more of any of the following: kerosine, mineral seal oil, naphtha, gasoline, benzine, mineral spirits, paint thinner, Stoddard solvent.

We in the oil industry feel that benzine is an obsolete term and should be removed from this list. Furthermore, there is a great tendency to get it confused with the aromatic compound, benzene, which is much more hazardous. We also feel that the term paint thinner is entirely too broad because some paint thinners on the market today are not entirely petroleum distillates. Some contain materials which may be considerably more toxic and far more hazardous than the petroleum distillates such as VM&P naphtha.

6. *Strong sensitizers*: The Commissioner has classified the following materials as strong sensitizers and, therefore, hazardous under the Act:

a. Paraphenylenediamine and products containing it.
b. Powdered orris root and products containing it.
c. Certain epoxy resins.
d. Formaldehyde and products containing 1 per cent or more of formaldehyde.
e. Oil of bergamot and products containing 2 per cent or more of oil of bergamot.

The three other categories of hazardous substances which are covered by the Act but are not too pertinent to this discussion include *corrosive, irritant and radioactive substances.*

Toxicity of Greases

At this point you are probably wondering about greases and lubricants. Conventional greases are, in my opinion, not hazardous under any of the toxicity classifications in the Federal Hazardous Substances Labeling Act. This opinion should not be taken as applying to every grease on the market. It is based on information that has been developed from various sources on the toxicity of conventional greases and a knowledge of their composition. Here are some toxicity figures relating to various greases. A sodium soap grease containing about 11 per cent of soap had an LD/50 of over 25 gm/kg. Another sodium soap grease, this one containing 15 per cent of the sodium soap, did not produce any local or systemic injury at a dose of approximately 8 gm/kg when applied to the skin for 24 hours. A lithium grease with 10 per cent of soap had an oral LD/50 of 37.5 gm/kg. Another lithium grease with the same amount of soap (10 per cent) had an LD/50 greater than 30 gm/kg. A grease containing about 8 per cent of calcium soap, 13 per cent of lithium soap, about 20 per cent mineral oil, and about 60 per cent of a synthetic ester was found to have an oral LD/50 of 20-25 gm/kg. A thread lubricant containing 40 per cent of a calcium grease and 60 per cent zinc had an oral LD/0 greater than 16 gm/kg. The LD/0 of a grease containing 7 per cent of a lead soap and 11 per cent sodium soap was about 13 gm/kg. One product that contained about 10 per cent calcium soap, about 30 per cent of red lead, and about 60 per cent mineral oil had an LD/0 in excess of 65 gm/kg. These figures, in my opinion, indicate that there is no need for precautionary labels under the federal law on these types of greases. Furthermore, greases are normally considered as industrial products and usually only the very common types would be expected to be found in a household.

Toxicity of Lubricants

The term lubricants covers a wide variety of petroleum products. Some lubricating oils are straight mineral oils, others contain one or more of a variety of different additives. It is impossible to make any generalizations because of this wide variation in formulas, but again it is my opinion that very few, if any, of the lubricants that might be found around a household would be subject to the federal Act. For example, a motor oil containing a barium detergent had an oral LD/50 in excess of 32 gm/kg. Tests on an experimental motor oil containing a purchased barium sulfonate had an LD/50 of 60 ml/kg. A sulfurized mineral oil containing about 8 per cent of a lead soap of naphthenic acids had an oral LD/50 of 70 ml/kg. A straight 100 pale oil had an LD/0 much higher than 16 ml/kg. An automatic transmission fluid containing a barium additive was found to be "relatively non-toxic" when administered orally to rats.

Guarantees

The law and regulations provide that a person is not subject to the penalties of the Act if he has a written guarantee from the supplier stating to the effect that the product is labeled in accordance with the law. Giving a guarantee of this sort has some pitfalls and a word of caution is indicated. For example, the regulations specify in detail the toxicity test methods to be used and does not allow for the use of alternate procedures that would yield equally reliable answers. Therefore, unless a material has been tested according to the procedures in the regulations, it would seem that any guarantee under the law could not be made.

Transitional Period

One of the principal problems that industry faces is the matter of labeling or re-labeling materials that are in inventory or on dealers' shelves when the penalty provisions become effective February 1, 1962. The FDA will permit the use of stick-on labels or other means to bring the packages into conformity with the law. I believe that the FDA does not fully comprehend the magnitude of such a re-labeling job. Many hazardous materials already have labels which may be technically in violation on the 1st of February, 1962 and, while the FDA says that it will not carry on a vigorous enforcement campaign against these

technical violations, the fact remains that many packages will be in technical violation next February. A manufacturer, no matter how faithfully he attempted to re-label his containers of hazardous materials, could easily miss some. If a claim were filed against the manufacturer because of some injury from this product, I doubt if he would have much of a defense if he maintained that the package was misbranded only because of a technicality and that, therefore, the FDA had not done anything about it. Practically all of the industry associations feel that a further extension of the penalty date is necessary to provide time to dispose of materials that will be in violation of the law next February. Because of this situation, Representative Kilgore introduced HR 9374 on September 22, 1961 to extend the effective date until February 1, 1963, but Congress adjourned without any action. Senator Magnuson and Representative Roberts have stated that they plan to review the problem of inventories early in January and if they find that the problem still exists at that time, they will support legislation to extend the effective date. How much can be accomplished in the month of January on this matter is only conjecture at this time. The FDA has stated that "It is not our intention to introduce, foster, or support extension legislation. If a hearing is held on any legislation introduced, we will, of course, testify factually if called upon to do so."

Components of a Precautionary Label

The components of a precautionary label that will be required under the federal Act are the same that have been advocated by various industry associations for some years now, have been used by many manufacturers of hazardous materials, and have been required under many existing state labeling laws. The following items must appear on a precautionary label:

1. Name and address of the manufacturer.

2. The common, usual, or chemical name of the hazardous substance or hazardous ingredients.

3. A signal word to indicate the degree of hazard. "Danger" for substances with an extreme hazard such as those that are extremely flammable, corrosive, or highly toxic; "Caution" for substances with the lowest degree of hazard, and "Warning" for substances intermediate between those requiring the word, "Danger" or the word, "Caution." The word, "Poison" and the skull and crossbones symbol must be used for highly toxic substances.

4. An affirmative statement of the principal hazard or hazards such as flammable, vapor harmful, harmful if swallowed.

5. Precautionary measures to be followed or avoided.

6. Instructions, when necessary, for emergency or first-aid treatment.

7. Instructions for handling and storage of packages which require special care.

8. The statement "Keep out of reach of children."

The federal law requires that the signal word appear in not less than 18-point type and the statement of hazard not less than 12-point type unless the label space on the package is too small to accommodate such type sizes. In such cases, reductions are permitted, but in no event smaller than 6-point type. The other components of the label shall be in type not less than 10-point in size unless adequate space is unavailable, in which event type no smaller than 6-point may be used.

The FDA originally proposed that the entire precautionary label appear on the main panel of the package. The August 12th regulations have relaxed this requirement somewhat and will permit splitting of the label. The signal word and the statement of hazard must still appear on the main panel together with a statement directing attention to the precautionary information elsewhere on the package. Practically all of industry feels that the splitting of the label components is not desirable and prefers that the location of the precautionary information not be specified. To date, the FDA has not been sympathetic to this proposal.

The law requires that the label information be displayed prominently and conspicuously. According to the regulations, some of the factors that affect prominence or conspicuousness are location, size of type, and contrast of printing against background. This prominence shall be achieved by placing the information within the borders of a square or rectangle and by use of suitable contrasts with the background by distinctive typography or color. One additional requirement is that all accompanying literature which includes any directions for use shall bear all the precautionary information that is shown on the container. ■

About the Author

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The Experience of the Ordnance Corps With Greases Made from Low Viscosity Oils

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Presented at the NLGI 29th annual meeting in Houston, October, 1961

Introduction

In September, 1947 the Ordnance Corps started a project to establish the characteristics of one grease suitable for lubrication of automotive and artillery equipment under extremes of arctic and tropic conditions. With the advice of the Coordinating Research Council, twelve greases were selected as likely possibilities and screening tests were made on them. Six of these were considered promising enough on the basis of the laboratory data to warrant testing in vehicles. The characteristics of these greases are given in Tables I and II.

TABLE I

Greases Used in Operation "Greaseball"

Grease Designation	*Specification*	*Composition*
RLG 163	AXS-1169 OD #00	Lithium soap-mineral oil
RLG 165	AXS-781 OD #0	Lithium soap-mineral oil
RLG 167	AN-G-25	Lithium soap-mineral oil diester blend
RLG 169	AXS-1169 OD #00	Sodium-calcium soap-mineral oil
RLG 170	AXS-1169 OD #00	Lithium soap-glycol
RLG 172	2108B	Sodium soap-mineral oil
RLG 173		Lithium soap-mineral oil diester blend
RLG 174		Sodium-calcium soap-mineral oil diester blend

TABLE II

Greases Used in Operation "Greaseball"

Grease Designation	*Oil Viscosity SUS* 100°F	210°F	*Worked Pen.*	*Starting Torque ft. lbs. −70°F*	*CRC Wheel Bearing at 250°F*
RLG 163	58	35	310	5.3	Unsatisfactory Excessive evap.
RLG 165	216	46	284	149.3	Satisfactory
RLG 167	72	37	267	8.3	Satisfactory
RLG 169	110	41	262	96.8	Satisfactory
RLG 170	145	45	237	47.3	Satisfactory
RLG 172	905	78	295	179.3	Unsatisfactory Abnormal change in structure
RLG 173	429	71	279	32.3	Satisfactory
RLG 174	442	83	277	5.3	Unsatisfactory Hardened

In Table I are found the RLG designation of the grease, the specification to which it conformed and the composition. Table II lists some important characteristics of the grease and the oil from which it was made. Since RLG 172 and RLG 174 failed during the test as explained below and had to be replaced, the successful greases were, with the exception of RLG 169, composed of lithium soap and low viscosity mineral or synthetic oil. The starting torque values listed in Table II were those required to start the wheels of a truck which had been soaked at the stated temperature for 24 hours. The results of the CRC Wheel Bearing Test at 250°F also appear to be a valid screening test for the greases. The two that failed this test because of hardening or structural changes were the two that failed during the field testing as explained below.

Operation Greaseball

In August, 1948 twelve 2-½ ton 6 x 6 trucks left Aberdeen Proving Grounds, Maryland, for California. The trucks were lubricated with the six selected greases, one grease to each of two trucks. The truck convoy was accompanied by two auxiliary vehicles, one hospital and one supply, which were lubricated with a 2108B wheel bearing grease (RLG 172) and a 500 sec. diester-mineral oil blend-lithium soap grease (RLG 173) respectively.

Upon reaching California, the fleet was operated for approximately 4000 miles in the desert. The vehicles were then inspected at Benicia Arsenal and the bearings repacked and new seals installed where contamination was evident. The sodium-calcium grease (RLG 174) was replaced with its counterpart, the lithium-soap grease (RLG 173), because of excessive hardening of the former.

After the Benicia inspection, the fleet proceeded over the Alcan highway to Alaska and spent the winter at Ladd Field, Fairbanks. The trucks were operated daily while in Alaska. All of the greases performed satisfactorily except the 2108B wheel bearing grease (RLG 172) which had to be replaced because of failure to function at low temperatures. In the spring, the fleet returned to Aberdeen and samples of the greases were

taken from the wheel bearings of the vehicles and sent to Rock Island Arsenal for examination.

Because of considerable contamination by gear oil due to broken or leaking seals, it was impossible to make any clear-cut decisions. However, where there was no gear oil contamination, the greases showed virtually no change and were in excellent condition. All six greases appeared to be satisfactory from the standpoint of wear prevention and grease breakdown under both arctic and desert conditions. No greases ran from the bearings under desert conditions and their low temperature torque characteristics were such that no difficulties were experienced at the lowest temperatures encountered in Alaska.

Benicia Testing 1949-51

It was felt that further desert testing was desirable since there was a question of the ability of greases made from such low viscosity oils to perform at the high temperatures anticipated in desert operations. Consequently greases RLG 163, RLG 165, RLG 170 and RLG 173 were chosen as covering the complete range of oil types and viscosities of the test greases. Testing was continued on these greases at Benicia and later at Southwest Research Institute. Inspections were made at 10,000 miles and at 18,650 miles at Benicia and at 30,000 miles at Southwest Research Institute. The general conclusions were:

1. Better seals were necessary to eliminate contamination by gear oils.

2. Where the quantity of lubricant was sufficient, the bearings were bright and in good condition and the lubrication was judged adequate.

3. Where the quantity of lubricant was insufficient, some channeling was evident resulting in the bearings running on the dry side which caused staining and discoloration.

4. There was one case of mechanical failure of a bearing.

Test Programs at Southwest Research Institute and at Yuma

The 1952 test programs held at Southwest Research Institute and at Yuma, Arizona were designed to furnish information which could be used by the Ordnance Corps in firming up MIL-G-10924. The greases used corresponded to AXS-1169 OD #00 type and are described in Table III.

TABLE III

Characteristics of Greases Used in 1952 Tests

Grease Designation	*Oil Viscosity SUS* 100°F	210°F	*Worked Pen.*	*Thickener Type*	*Oil Type*
RLG 189-51	68	35	287	Lithium soap	Mineral
RLG 190-51	60	35	280	Lithium soap	Mineral
RLG 191-51	60	35	304	Lithium soap	Mineral
RLG 192-51	130	41	330	Clay-amine thickener	Mineral

The test fleet consisted of twelve Army Cargo trucks, four each of ¾ ton, 2-½ ton and 5 ton capacities. They were driven 30,000 miles over hard-surfaced roads at an average speed of 41-43 miles per hour. They carried their highway-rated loads, and one truck of each type was lubricated with each of the greases under test.

Upon termination of the test, all greases were found satisfactory except RLG 192-51 which showed excessive wear. The Joint CRC-Military inspection committee recommended that the greases be improved in regards to mechanical stability and oil separation and that improvements in compounding be made in order to reduce some tendency toward borderline lubrication.

The tests at Yuma were run on three #00 greases which had met the requirements of MIL-G-10924 (Ord) except for one calcium soap grease which failed the specified minimum dropping point of 300°F. This grease was of interest because of the comparative shortage at that time and higher price of the lithium soaps used almost exclusively in MIL-G-10924 greases to that date. The trucks accumulated 10,000 miles, mostly in Death Valley. Inspections at the completion of the test indicated results similar to those at Southwest and resulted in similar recommendations. The calcium soap grease (280°F dropping point) performed satisfactorily and the dropping point was subsequently removed from Specification MIL-G-10924.

Specification Greases Get a Severe Test in 1953

In 1953 tests were run at both San Antonio and Yuma on greases which had qualified for Specification MIL-G-10924 (Amend. 2). Included in the Yuma testing was one 2108B wheel bearing grease for comparative purposes. The description of the greases is included in Table IV.

TABLE IV

MIL-G-10924 (Amend 2) Greases Used in 1953 Test Program

Grease Designation	*Oil Viscosity SUS* 100°F	210°F	*Worked Pen.*	*Thickener Type*	*Oil Type*
RLG 206	69	36	284	Ca soap	Mineral Oil
RLG 207	88	38	310	Li-Ca soap	Mineral Oil
RLG 208	83	37	287	Ca soap	Mineral Oil
RLG 209	81	37.4	285	Li-Ca soap	Mineral Oil
RLG 210	79	37	285	Ca soap	Mineral Oil
RLG 211	75	36	290	Li soap	Mineral Oil
7389	75.3	36.5	275	Ca soap	Mineral Oil

It will be noted that several of the greases tested were calcium soap greases and that all have low viscosity oils.

The tests at Southwest Research Institute involved the same twelve trucks used in previous tests and the accumulation of 20,000 miles on them. Inspection at the conclusion of the tests rated all lubricants as adequate and the over-all condition of the bearings as good.

Fifteen assorted cargo vehicles were involved in the tests at Yuma in which 9500 miles were accumulated. The procedure at Yuma included fording operations

at the end of each 500 miles for the first 3000 miles during which the vehicles were driven hub-deep in water for five minutes. Ten of the vehicles had slots cut into the inner wheel seals to insure the passage of water into the hubs during the fording operation. Upon completion of this 3000-mile phase of the testing, the grease and bearings were inspected. Many bearings had to be replaced, some were regreased and all slotted inner seals were replaced.

The second phase of the operation was conducted in the mountainous terrain of Death Valley. Braking operations on the down grades produced temperatures up to 180°F during normal operations and up to 300°F during deliberately imposed abnormal conditions.

The final phase was conducted in the vicinity of Yuma test station. The ¼ and ¾ ton trucks were regreased at the beginning of this phase and some of the seals were slotted as in phase 1 and the vehicles forded as before. The remaining vehicles continued to operate without fording.

Inspection revealed that under dry conditions the over-all lubrication picture was good. Results of the fording operations rated all greases poor. The inspection committee reported that there was a definite improvement in stability of the greases tested this year over last and that there was less discoloration. There was little difference from a stability standpoint between the 10924 and 2108B greases, but the 2108B showed up a little better from the rust protective standpoint.

The Testing is Finalized

Tests were conducted in 1954 on fifteen trucks for 10,000 miles, in 1955 on fifteen trucks for 10,000 miles and in 1956 on sixteen trucks for 10,000 miles. While the emphasis these last three years was on lubricants other than greases, at least one or more greases were tested each year. In all cases they were greases which had qualified under MIL-G-10924, Amendments 2 or 3 and consequently were made from oils of less than 100 SUS at 100°F. All inspection reports were that the greases gave adequate lubrication and the bearings were in good condition at the conclusion of the tests.

This tremendous testing program, carried out over a period of eight years, involved a total of 140 cargo trucks of various types driven a total distance of 2-¼ million miles. In addition, various types of trailers and Ordnance equipment were towed at various times during the test program. The terrain covered included samples of practically all types found in the North American continent. Climatic conditions ranged from that found in the Arctic to the most arid deserts. In many instances, the trucks were deliberately overloaded and driven under abnormally severe conditions. Out of this test program came the general purpose grease now designated as MIL-G-10924A, Grease, Automotive and Artillery. It constitutes the largest single grease item used by the Armed Services and purchases during fiscal year 1960 totaled over 11 million pounds. This does not include purchases made by private concerns to be used on equipment manufactured for the Military. No record of these latter purchases is available.

The greases meeting MIL-G-10924A performed satisfactorily throughout the test program. They equalled or surpassed the performance of greases previously used in such equipment. Whenever a weakness appeared it was quickly corrected, for example: mechanical stability, bleeding, water resistance, etc.

The Product

MIL-G-10924A grease is now used throughout the Armed Services as a general lubricant for automotive and artillery equipment. Its performance has been quite satisfactory. Occasionally reports of malfunctioning of the grease in various types of equipment or in dispensing systems would be received. The writer has had occasion to be one of the investigating team for several such complaints. In all cases, the trouble was found to be a design difficulty or faulty methods of lubricant application or use. In one case not personally investigated by the writer, which involved difficulty in dispensing, some of the grease was sent to the laboratory for checking. Examination disclosed that the grease was much stiffer and had a higher apparent viscosity than the specification limits. Evidently it had been stored under high temperature conditions for a long period of time or a sub-standard batch had somehow gotten past the inspector.

Rock Island Arsenal has had several occasions to test the adequacy of MIL-G-10924A greases to lubricate under new or severe conditions. On one occasion, the question of the adequacy of the grease to lubricate ball joint suspensions came up. With the cooperation of the post garage, the following test was set up. The complete unit, upper and lower suspension, for one side of a Chevrolet was cleaned thoroughly and packed with MIL-G-10924A grease by the laboratory. The grease fittings were removed and replaced by plugs to prevent addition of more grease. These fittings were installed on one side of a car used in cross country service. The other side of the car had the usual suspensions with grease fittings and received the usual 1000 mile servicings. After 6500 miles had been accumulated on the car, the experiment was stopped. The ball joint suspension which was sealed and had received no lubricant was operating satisfactorily and was in good condition.

On another occasion and at another installation, the question came up as to the adequacy of the grease in heavy equipment. The wheel bearings and hubs of a LeTourneau earth mover were cleaned thoroughly with solvent and lubricated with MIL-G-10924A grease. The vehicle was then loaded to its full capacity with dirt (18 cu. yds.) and pulled at 20 mph over dirt roads for 24 hours. No attempt was made to obtain

temperature readings of the bearings but the hubs became so hot that it was almost impossible to hold the unprotected hand on them. At the end of the test period, examination disclosed both grease and bearings in excellent condition. The lubrication was considered adequate in all respects.

The viscosities and viscosity indices of the oils used in the presently qualified MIL-G-10924A greases are shown in Table V. While the viscosities at 100°F fall within a relatively narrow range, the viscosity indices cover a wider range and indicate considerable variation

TABLE V

Viscosity at 100°F and Viscosity Indices of Oils from Qualified MIL-G-10924A Greases

Grease No.	*Viscosity, SUS*	*Viscosity Index*
1	79.2	72
2	80	49
3	69	40
4	77	48
5	75	49
6	87	55
7	89	72
8	70	55
9	84	49
10	85	100
11	76	50
12	70	45
13	68	46

in oil type and composition. In spite of this, the greases exhibit a remarkable uniformity in performance. This is so much so that in any investigation carried out by RIA Laboratory no attempt was made to select greases made by any particular manufacturer. Whichever grease happened to be on hand in sufficient quantity was used.

Industry Accepts It

Greases meeting MIL-G-10924A are in increasing demand by various industrial users. Mr. G. K. Brower, project engineer of International Harvester Co., in his article, "Lubricating the Construction Giants"[1], makes these statements. "General purpose, all purpose or multipurpose grease is used primarily as a wheel bearing lubricant and at temperatures below 10°F in certain water pumps and fan hubs. It is recommended that this grease be a product qualified as a MIL-G-10924A-Grease, Automotive and Artillery. This product has performed excellently as a wheel bearing grease and for low temperature general purpose use." He continues by stating that the grease does not do so well at high temperatures, is not readily available to industry, and that the development of an improved version of MIL-G-10924A suitable for higher temperatures and available commercially is highly desirable.

A publication sponsored by a large commercial grease manufacturer[2] contains the following statement, "Since outboard motor boats are getting bigger and heavier, it is generally necessary to launch them from their trailers by backing the trailer into the water and letting the boat float free. But after this little maneuver occurs several times, we find that the wheel bearings begin to rust and eventually seize. A very good remedy for this disturbing situation can be had by using the proper lubricating grease. The best lubricant for this purpose is a product fitting the Government Specification MIL-G-10924A. A handsome profit could be made by some smart operator by selling the MIL-G-10924A lubricating grease in specialty packages, and labeling it, 'Boat Trailer Wheel Bearing Grease.' "

Grease meeting Specification MIL-G-10924A was used in lubricating the special vehicles Sno-Cots, Muskegs, Weasels, etc., that were used in the Trans-Antarctic Expedition of 1957-58. The grease proved adequate under the severe conditions and evoked favorable comment from the officers in charge[3].

There is little doubt but that greases made from oils of higher viscosity would perform better under extreme conditions of elevated temperatures and extended periods with no relubrication. It has been shown conclusively in service, however, that greases made from a light oil will perform satisfactorily under the temperature range for which they are designed, −65° to 225°F, and under conditions of moderately severe service.

Bibliography

1. Brower, G. K., "Lubricating the Construction Giants," *NLGI Spokesman* Vol. 21, No. 11, page 21; February, 1958.
2. Battenfeld Technical Letter, Vol. 3, No. 6, June, 1959.
3. "Lubricating Vehicles in the Antarctic," *Scientific Lubrication*, Vol. 2, No. 5, May, 1959, page 26.

About the Author

S. F. CALHOUN *received a BS degree in chemistry from Iowa Wesleyan college and an MS from the State University of Iowa. While in college he served as a research assistant, doing research on chlorination of fatty acids, the ethanol-carbon tetrachloride system and the oxidation of benzene derivatives. He spent a number of years teaching before joining the research department of the Rock Island Arsenal. At present, he is in charge of the petroleum products unit of the laboratory. Mr. Calhoun has done research on synthetic lubricants, grease additives, oil separation from greases, and has worked on missile fuel test equipment. Author of several papers and a previous contributor to the* SPOKESMAN, *he is a member of the American Chemical Society.*

Discussion of NLGI-ASTM Symposium Paper on The Experience of the Ordnance Corps With Greases Made from Low Viscosity Oils

By: G. K. Brower

International Harvester Co.

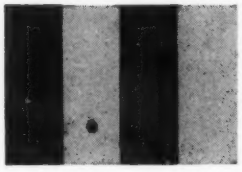
The results of eight years and 2-¼ million miles of performance testing, as presented by Mr. S. Fred Calhoun in his paper on "The Experience of the Ordnance Corps with Greases Made From Low Viscosity Oils," are worthy of serious consideration.

The author is to be complimented on the clear, concise and thorough manner in which he has presented his data. The conclusions are sound.

In substantiation of the author's conclusions, I might point out that the International Harvester Co. has for several years used the Mil-G-10924A grease, at its Works, as a general chassis and wheel bearing lubricant for construction equipment vehicles numbering in the thousands. The units so lubricated include: crawler tractors weighing in excess of 23 tons; scrapers up to 36 tons or 24 cu. yd. capacity with a gross weight of approximately 144,000 lbs.; rear-dump (Payhaulers) and bottom-dump (Paywagons) off-highway trucks with rated capacities from 19 tons or 12.5 cu. yd. to 65 tons or 81.2 cu. yd. These units have maximum gross weights ranging from 75,000 to approximately 198,000 lbs. and a maximum speed of 35 m.p.h.

We have also specified that the Mil-G-10924A grease be used in service for the lubrication of wheel bearings and as an option to chassis grease for all other grease lubricated points except the engine clutch points of crawler tractors and power units. These latter require a high temperature grease of the Mil-L-3545 type.

It may be of some interest to those present to know that, during the subsequent thousands of hours of operations, we have never had a complaint as regards the performance of the Mil-G-10924A grease. We have had unsatisfactory reports when other type greases were used in the same units. Most of these problems were associated with too heavy a consistency during winter operations. It should be noted that these units are sold throughout the Free World; they have operated at ambient temperatures of minus 25°F to over 110°F. in arid wastes, mud and muck, coal piles, rock, etc., and all components have been subjected to severe shock and high unit loading. We believe this experience aptly confirms the conclusions reached by Mr. Calhoun that "greases made from a light oil will perform satisfactorily under the temperature range for which they are designed; –65 to 225°F., and under conditions of moderately severe duty." May I again commend the author for a job well done. ■



Future Meetings

JANUARY, 1962

8-12 Society of Automotive Engineers, Annual Meeting, Cobo Hall, Detroit, Mich.

21-26 ASTM Committee D-2 meeting, Chase-Park Plaza Hotels, St. Louis, Mo.

FEBRUARY, 1962

21 NLGI Board of Directors meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

APRIL, 1962

2-3 National Petroleum Refiners Association, Spring Meeting, Granada Hotel, San Antonio.

MAY, 1962

21-22 API Division of Marketing Lubrication Committee, meeting of subcommittee and technical program session, The Chanteclar Hotel, Ste. Adele-en-haut, Quebec, Canada.

22-25 API Division of Marketing, Midyear Meeting, Queen Elizabeth Hotel, Montreal, Canada.

JUNE, 1962

4-6 ASME Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

10-15 ASME Summer Annual Meeting, Hotel Frontenac, Quebec, Canada.

24-29 ASTM Annual Meeting and Apparatus Exhibition, Statler-Hilton Hotel, New York City.

SEPTEMBER, 1962

12-14 National Petroleum Refiners Association, Fall Meeting, Traymore Hotel, Atlantic City.

OCTOBER, 1962

16-18 ASME-ASLE Lubrication Conference, Pittsburgh Hilton Hotel, Pittsburgh, Pa.

21-24 NLGI 30th Annual Meeting, Edgewater Beach Hotel, Chicago.

NOVEMBER, 1962

25-30 ASME Winter Annual Meeting, Statler Hilton Hotel, New York City.

OCTOBER, 1963

27-30 NLGI 31st Annual Meeting, Hotel Roosevelt, New York.

OCTOBER, 1964

25-28 NLGI 32nd Annual Meeting, Edgewater Beach Hotel, Chicago.

OCTOBER, 1965

24-27 NLGI 33rd Annual Meeting, Fairmont Hotel, San Francisco.

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Literature and Patent Abstracts

Composition

Lubricating Greases Containing Mercaptobenzothiazole Ester Derivatives

Morway and Bartlett (U.S. Patent 2,985,590, assigned to Esso Research and Engineering Co.) find that 2-mercaptobenzothiazole acetic acid or esters of the same are useful in lubricating greases. The acid may be used in conjunction with acetic and fatty acids to form complexes which in turn thicken lubricating oils. Or the ester may be used as a portion or all of the fluid component of lubricating greases.

Thus, using the typical method for preparing calcium soap-salt thickeners, a product was made from 12 per cent of glacial acetic acid, 3 per cent of 2-mercaptobenzothiazole acetic acid, 3 per cent stearic acid, 9 per cent hydrated lime, 0.5 per cent phenyl alpha naphthylamine and 72.5 per cent of an oil having a viscosity of 55 SUS at 210°F. This lubricant had a worked penetration of 310, a dropping point of 500+°F, a lubricating life of 1034 hours in a bearing operating at 10,000 rpm and 250°F, and a pass on a Timken test with a load of 45 pounds.

Since these esters have EP value due to their sulfur content, a lubricating grease was made from 12 per cent glacial acetic acid, 6 per cent commercial capric acid, 9.8 per cent hydrated lime, 1 per cent of phenyl alpha naphthylamine and 71.2 per cent of 2-mercaptobenzothiazole acetic acid C_{13} Oxo ester. This had characteristics similar to the first lubricating grease except that the life in the bearing test was 1700+ hours and a pressure wear index was 50.3.

Lubricating Greases Containing Metal Salts of N-Alkanoyl-Sulfanilic Acids

According to Odell and Lyons (U.S. Patent 2,987,477, assigned to Texaco Inc.) lubricating oils thickened with metal salts of N-alkanoyl-sulfanilic acids form lubricating greases having high dropping points, good shear stability and excellent water resistance. While it is stated that alkali metals, alkaline earth metals, or aluminum or zinc may be used, the illustration includes only calcium, sodium and zinc salts.

In forming such a lubricant, a N-stearoyl sulfanilic acid was first prepared by adding 600 milliliters of pyridine and 115 grams of sulfanilic acid to a solution of 292 grams of stearoyl chloride in 600 milliliters of benzene. The mixture was heated to reflux for two hours, filtered hot, and the clear solution cooled to 10°C and refiltered. The precipitate was washed with acetone and dried in vacuo to give a product which softened at 80-85°C.

To prepare the lubricating grease, 109 grams of the above sulfanilic acid, 550 grams of water, 131 grams of a naphthenic oil having a viscosity of 315 SUS at 100°F and 14.1 grams of hydrated lime were mixed and heated to 180-190°F for two hours. The mass was then further heated to 450°F and maintained at this temperature for about ten

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minutes before cooling while stirring. When the mixture had cooled to 341°F, an additional 323 grams of oil were added gradually. The mass was given two passes through a Premier colloid mill when the temperature had dropped to 200°F.

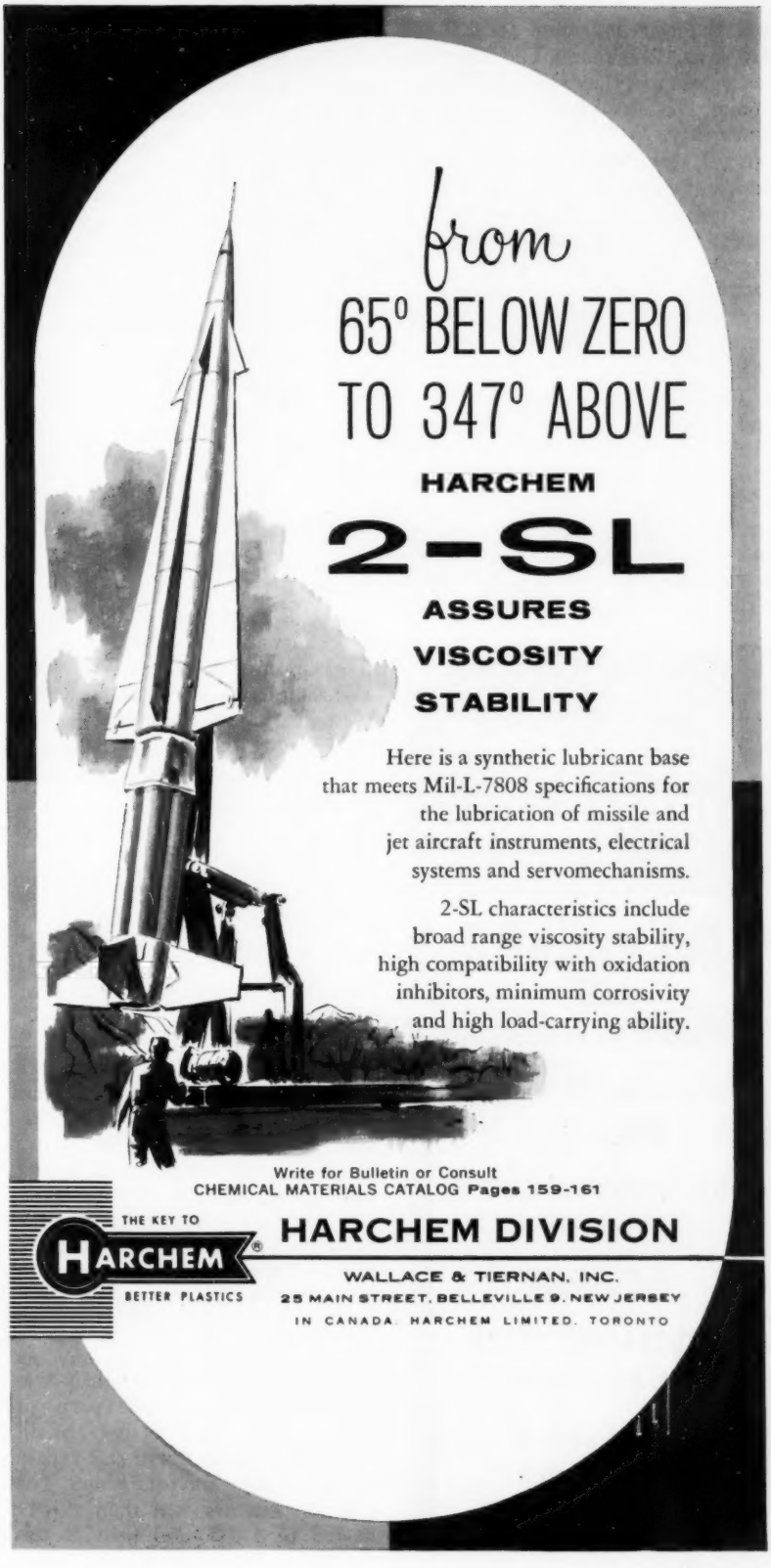
The product was a No. 0 grade with a buttery texture, a dropping point above 500°F, a good shear stability and water resistance.

Anti-Friction Bearing Lubricating Grease

A lubricating grease particularly adapted for use in sealed-for-life anti-friction bearings is described by Norton and Pattenden in U.S. Patent 2,988,507, assigned to Esso Research and Engineering Co. The product consists of a lubricating oil thickened with fifteen to 40 per cent of a mixture of sodium crotonate and the sodium soap of an unsaturated mono-carboxylic acid used in such proportions that the molar ratio is 0.1 to 10.0. Also included in the mixture is 0.1 to 15 per cent by weight of either disodium phosphate or trisodium phosphate.

During the manufacture of this lubricant the sodium salt, sodium soap and the phosphate with at least a portion of the oil are heated to 300 to 425°F for twenty minutes to four hours in order to form a complex. Such treatment also improves the oxidation resistance of the finished product.

For example, 900 pounds of a solvent refined oil having a viscosity of 550 SUS at 100°F and 90 VI, 210 pounds of crotonic acid and 760 pounds of oleic acid were charged to a gas-fired kettle. After heating this mixture to 150°F, 420 pounds of 50 Bé. sodium hydroxide, followed by 100 pounds of water were added. After dehydrating at 300°F, the excess alkali was adjusted to the range of 0.1 to 0.4 per cent as sodium hydroxide. While maintaining the temperature of the mass at 300°F, 286 pounds of trisodium phosphate hydrate (50 per cent water) dissolved in an equal amount of water were added in small increments. After complete dehydration 650 pounds more oil were added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and the heat increased to 400 to 420°F for 30 minutes. The lubricating grease was then transferred to a cooling vessel where it was stirred constantly. At 200°F, 29 pounds of phenyl alpha naphthylamine were added and the product was milled. At this point additional oil was required to bring the lubricating grease within a worked penetration range of 180 to 260. The latter figure is the maximum penetration permitted to give a satisfactory anti-friction bearing lubricant.

The finished lubricating grease had a worked penetration of 215, a dropping point of 500+, a pressure drop on the Norma-Hoffman bomb of 1.5 pounds in 100 hours and 3.5 pounds in 500 hours, an NLGI spindle life of 2850 hours at 300°F, a Timken EP load of 38 pounds and a running-in temperature rise on an NLGI spindle of 15°F.

The latter test shows approximately the same temperature rise as a modified Norma-Hoffman S-3609 bearing test. In the NLGI spindle test, 2 grams of lubricant are placed in a Norma-Hoffman 204 bearing and the bearing and shields replaced on the spindle shaft. The bearing is then rotated at 10,000 rpm for 20 hours on and four hours off, cycles. The maximum temperature rise above ambient is taken as the running-in temperature. For best operation, this figure should be as low as possible and in the product just described will be under 30°F.

Additives

Oxidation Inhibitors for Lubricating Greases

In U.S. Patent 2,990,368, assigned to Universal Oil Products Co., Thompson states that alkylaminocarbazoles act as inhibitors against the oxidation of lubricating greases.

As an illustration of such value, a lithium base product is cited which on a bomb oxidation test had an induction period of ten hours. After the addition of 1 per cent of 3-octylaminocarbazole, the induction period was raised to 31 hours.

Composition

Lubricating Greases Containing an Imidazoline

Andress and Butcosk (see U.S. Patent 2,991,249, assigned to Socony Mobil Oil Co., Inc.) found that lubricating greases characterized by excellent feedability, water resistance and corrosion resistance can be formed with certain combinations of soaps and reaction products obtained by reacting naphthenic acids with ethylenepolyamines. The useful soaps are those of calcium, lithium, or mixtures of the two soaps.

A suitable imidazoline was formed as follows: 500 parts of naphthenic acid and 91 parts of diethylene triamine were refluxed in xylene solution for four hours. The reaction mixture was then slowly heated to 275°F and held at this temperature until the water and xylene were removed.

As a base for introducing the above additive, a lithium-calcium soap lubricating grease was made from 0.66 per cent palmitic acid, 8.55 per cent stearic acid, 0.29 per cent oleic acid, 1.15 per cent lithium hydroxide monohydrate, 0.45 per cent hydrated lime, 0.2 per cent oxidation inhibitor, and 88.7 per cent naphthenic oil of 750 SUS at 100°F.

A lubricant made as above but containing 6 per cent of soap was placed in a 40-pound container and cooled to 37-38°F, after which a pump, likewise cooled and operating under 90 psi, removed 17.5 per cent of the lubricating grease before cavitation occurred. Next a product, containing 7 per cent of the mixed soap and also 1 per cent of the additive described, was subjected to the same conditions which resulted in removal of 61 per cent

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of the lubricant before cavitation occurred.

A lithium-calcium stearate product was subjected to a CRC corrosion test and permitted rusting. After addition of 1 per cent of the additive, no rusting occurred.

Ureido Compounds as Thickeners for Lubricating Greases

In British Patent 864,898, Standard Oil Co. of Indiana describes the formation of lubricating greases using the reaction products of modified abietyl amines and diisocyanates as the thickening agents. Various lubricating fluids can be used in the products which can therefore be employed at elevated temperatures.

For example, a lubricant was made from 6.3 g. of Rosin Amine D, 2.7 g. of 3,3′-dimethyl-4,4′-diisocyanato-diphenyl, 44.8 g. of a solvent extracted SAE 5 oil, 44.8 g. of di-isooctyl azelate, 0.3 g. of Ortholeum 300, 1 g. of Alox 125 and 0.1 g. of metal deactivator by heating and milling. The resulting lubricating grease had an unworked penetration of 293 and a drop point of 488°F.

Clay Base Lubricating Greases Stable To Contamination with Soap Bases

According to Sawyer and Haden (U.S. Patent 2,990,367, assigned to Philipp Corp.) addition of 0.1 to 5 per cent of ethyl silicate to clay-base lubricating greases will make such products compatible with soap thickened products.

A lubricant was made from 8.12 per cent fuller's earth, 2.58 per cent Amine S and 89.3 per cent of a Mid-Continent solvent refined oil having a viscosity of 1100 SUS at 100°F and an 84 VI. To a portion of this lubricating grease, 2 per cent of ethyl silicate was added. Then each portion was contaminated by mixing with 10 per cent of a No. 2 Grade of sodium base lubricant.

When the two mixtures were subjected to a CRC Wheel Bearing Test, the one containing the silicate ester showed a loss of 1.5 per cent whereas the other gave a loss of 37.4 per cent.

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Composition and Process

Semifluid Lubricating Grease

An EP semifluid lubricating grease, useful over a temperature range of −76 to 300°F, is described by Fisch in U.S. Patent 2,991,247, assigned to the United States of America. The lubricant was developed particularly for use on rotating and elevating mechanisms of guns.

The ingredients used consist of 80 to 89 per cent of a diester having a cs. viscosity at 100°F of 10 to 14, 8 to 17 per cent of lithium stearate, 1 per cent of di-isopropyl acid phosphite, 1.5 per cent of barium petroleum sulfonate and 0.5 per cent of 2,6-di-tertiary butyl para cresol.

After the mixture is made, the mass is heated to 185 to 195°C and then immediately chilled to −30°C at a rate of approximately 25°C per minute. A temperature higher than 195°F is not desirable since a thickened lubricating grease is not desired.

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The Literature and Patent Abstracts column is written for NLGI by C. J. Boner, chief research chemist for Battenfeld Grease and Oil of Kansas City, Missouri.

In an example, 89 per cent of di-2-ethyl hexyl sebacate and 8 per cent of lithium stearate were used. After the chilling, the mass was homogenized and entrained air removed. The lubricant is stated to be thixotropic.

Processing

Irradiation of Sodium Base Lubricating Greases

According to Natkin, Kolfenbach and Forster (U.S. Patent 2,990,346, assigned to Esso Research and Engineering Co.) sodium base lubricating greases can be improved by subjecting them to gamma ray irradiation. While such treatment can be carried out at temperatures of 50 to 200°F and under vacuum or pressure, it is also effective at room temperature and atmospheric pressure. Also the method of irradiation is not critical.

Examples are given of three products which were placed in the center of a cylindrical cobalt 60 source. One lubricant had been made from rapeseed oil by alkali fusion and contained an oil of 55 SUS at 210°F. After treatment, the lubricating grease was lighter in color and had less odor than before. There was no change in dropping point and practically none in penetration. Another product which had been made from hydrogenated fish oil fatty acids and a blend of a 50 SUS at 210 oil and a 181 SUS at 210 green oil, had an improved odor after treatment, an increase of 4°F in dropping point and an increase in penetration from 85 to 88 in a micro method. The final lubricating grease contained 12 per cent of sodium stearate and an oil of 55 SUS at 210°F. Irradiation resulted in a lighter color, an increase in dropping point of 36°F, and a change in micro-penetration from 203 to 243 mm/10.

In U.S. Patent 2,990,345 the above authors suggest irradiation of lithium base lubricating greases to increase the dropping points at least 10°F. Four examples show increases varying from 10° to 97°F after exposure to gamma rays.

Application

Aircraft Wheel Bearing Failures—Why?

E. B. Palmer, *Scientific Lubrication* 13, No. 6, pp 20-24 (1961).

It is pointed out that while MIL-L-3545 lubricating greases, consisting of sodium or calcium soap-petroleum oils, had proven satisfactory on propeller and early models of jet aircraft, this was not true with the B-58 or later model fighter aircraft. This is because these later types have internal brake wheel assemblies so that the heat must be dissipated through the wheel bearings.

Arylurea - pentaerythritol - ester type lubricating greases meeting specification MIL-G-25760 have been found satisfactory for the later model jets. The fluid in such lubricants has a temperature range of −65 to 350°F and the thickener is said to be stable up to 600°F.

However, Palmer points out that selecting a proper lubricant is only the beginning of a successful wheel bearing program. Cleaning of bearings and elimination of solid contaminates are of equal or greater importance. Therefore, details are given of the method of cleaning and inspection of bearings as well as grease seals. After the preliminary cleaning, the people handling the bearings wear rubber gloves and the inspectors wear white cotton gloves.

Finally, if the bearings are serviceable, they are preferably relubricated with a wheel bearing packer. Then, unless immediately replaced in the wheels, the bearings are stored in sealed envelopes.

Mention is made that "still further improvement in load carrying ability and lubricity may be obtained by adding 10 per cent by weight of micron sized molybdenum disulfide to the MIL-G-25760."

Industry News

ASTM Technical Committee G Report

Because of its interest to the entire industry, a report on the activities of the American Society for Testing and Materials, wherein they concern lubricating greases, is given below. These minutes consist of the report of Technical Committee G to ASTM Committee D-2 and of the reports of the active sections of Technical Committee G. They have been afforded NLGI by J. L. Dreher, Secretary of Tech G.

Report of Technical Committee G On Lubricating Grease

Chairman, C. L. Pope; First Vice-Chairman, E. W. Adams; Second Vice-Chairman, H. T. Peeples; Secretary, J. L. Dreher.

The Advisory Committee of Technical Committee G met on June 26 and 27, 1961. Chairman C. L. Pope presided. Minutes of the February 6 and 7, 1961, meetings were approved.

Technical Committee G reported the following summary of plans for the coming year:

1. An improved procedure for the determination of the Dropping Point will be sought. Preliminary studies indicate that the use of a preheated bath will save time without a material loss in repeatability and reproducibility.

2. A new subsection was formed with two groups: one to study both the Timken Machine and the Four-Ball Machine for the determination of extreme pressure properties, the other to study the Four-Ball Machine for the determination of wear.

3. A study group was formed to explore the need for the establishment of a procedure for the determination of oil separation from greases under pressure.

Respectfully submitted,
J. L. DREHER, Secretary,
Technical Committee G

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Report of Section G-I to Technical Committee G June 27, 1961

Subsection G-I-1 held a meeting on June 27 in Atlantic City. Most of the discussion hinged around the paragraphs on "Fillers, Insolubles, Ash, and Gypsum." It appears as though over the years this part of the grease analysis procedure has become too complex, giving great detail on materials that are hardly ever found in grease, yet failing to mention materials which are currently used.

Mr. Entwistle will try to rewrite pertinent areas of D 128 to simplify, clarify, and modernize these paragraphs. He hopes to have such information in the mail before the February meeting so that the matter may be discussed at that time. It is probable that the word "Fillers" will be eliminated. The present method includes a paragraph headed "Fillers," but in reporting, the value is called "Percentage of Insoluble Matter." By heading the paragraph "Insolubles" or "Insoluble Matter," any implications inherent in the word "Filler" would be eliminated, and the report would be consistent with the heading of the paragraph. This approach was satisfactory to the members attending the subsection meeting which was thereupon adjourned.

Some other matters pertinent to G-1 had been raised since the last period. One inquiry involved the Oxygen Bomb method, D 942. Under "Apparatus" the pressure gage is described as being "suitable for use with oxygen and mineral oil." Since liquid oxygen or high pressure oxygen could cause an explosion when used with mineral oil, the inquirer raised a question as to the accuracy or desirability of this phrase. However, Mr. Gisser has replied that this is a low pressure environment in which mineral oil and oxygen are present due to the fact that we are oxidizing lubricating grease. Insofar as we know, there has never been any difficulty experienced with the method or with the type of pressure gage used. We believe this matter is closed.

No action was taken on the carrier liquid used in water analysis. The change voted upon at the last meeting apparently is acceptable. It is worth noting that our British counterparts in the Institute of Petroleum are changing the specification of the solvent they use.

Some question had been raised on D 1261 with regard to the solvent used to wash the copper strips at the end of the analysis. The method calls for the use of "grease analysis naphtha," which is defined only as having an end point no higher than 200°F and little acidity (substantially neutral to alcoholic KOH). Grease analysis naphtha no longer appears in the grease analysis method; in its place hexane is used as a grease analysis naphtha. Hexane has a suitable end point and meets the acidity requirement as given. Therefore, it has been proposed that any reference to grease analysis naphtha be removed and this be rewritten as hexane. Since hexane does meet these requirements as given, the change would be editorial. There was no objection.

One other item was discussed. A proposed specification for hexane is printed in the 1961 D-2 report. This grade of hexane would be satisfactory for D 1261 in place of grease analysis naphtha. However, in D 128 we run into an odd limitation. In order to handle some of the higher melting fatty acids, such as hydroxy stearic acid and greases made from this material, it is necessary to heat the solution in hexane for filtration. The temperature at which the solution is to be maintained is above the 140 initial boiling point specified in the proposed tentative specification. A commercial material known as "High Purity Hexane" (available from Phillips) is inexpensive and has an initial boiling point of 151. This is enough above the 145°F specified in D 128 that there should be no trouble. Since grease people are usually involved in both D 128 and D 1261, it seems desirable that the same grade of hexane be specified for both of these methods. This would require that we specify a higher boiling or narrower cut hexane, such as the above-mentioned High Purity Hexane, in both D 128 and D 1261, and that the proposed specification for Commercial Hexane, which has another purpose, be disregarded for these analytical procedures. From the viewpoint of Technical Committee G and its members this appears to be the most desirable procedure, and steps will be taken to modify D 128 and D 1261 so that a commercial hexane such as Phillips' High Purity Hexane will be specified.

Respectfully submitted,
M. EHRLICH, Chairman

Report of Section G-II June 27, 1961

This section has been reorganized to consist of the following subsections:

Project	*Method*	*Chairman*
Penetration	D 217	J. L. Dreher
Dropping Point	D 566	P. R. McCarthy
Flow Characteristics	D 1092	L. C. Brunstrum
Storage Stability	D 1742	H. A. Woods
Deleterious Particles	D 1404	J. W. Johnson
Evaporation	D 972	Fred Calhoun
Micro Penetration	D 1403	George Entwistle
Roll Stability	.....	J. S. Aarons

Since February, attention has been given to four of the eight methods—one for final approval, one actively, and two editorially.

The roll stability project was completed in February. After some editorial work, the method was approved by letter ballot and is ready for printing.

Two modifications of a method for high temperature dropping point are being studied by nine laboratories. The report of the the chairman of this subsection is appended.

Two aspects of the evaporation method D 972 were considered. Confusion has arisen concerning the sample cups because the main figure describes the grease cup as "sample cup," whereas the appendix describes the "oil cup." It has been proposed to editorially insert the word grease in Figure I to make it read "grease sample cup."

The second question concerns precision, currently given as deviation from the mean and compares as follows with new data by the Institute of Petroleum:

	ASTM	IP
Repeatability, %	2.5	10
Reproducibility, %	10.0	22

The higher IP values may result from equipment variations, samples having less than 1 per cent evaporation, and different means for calculating precision. No action will be taken on the ASTM method for the present.

In method D 1092, the range for the gages does not agree in the text and figure. The figure will be editorially changed to agree with the text.

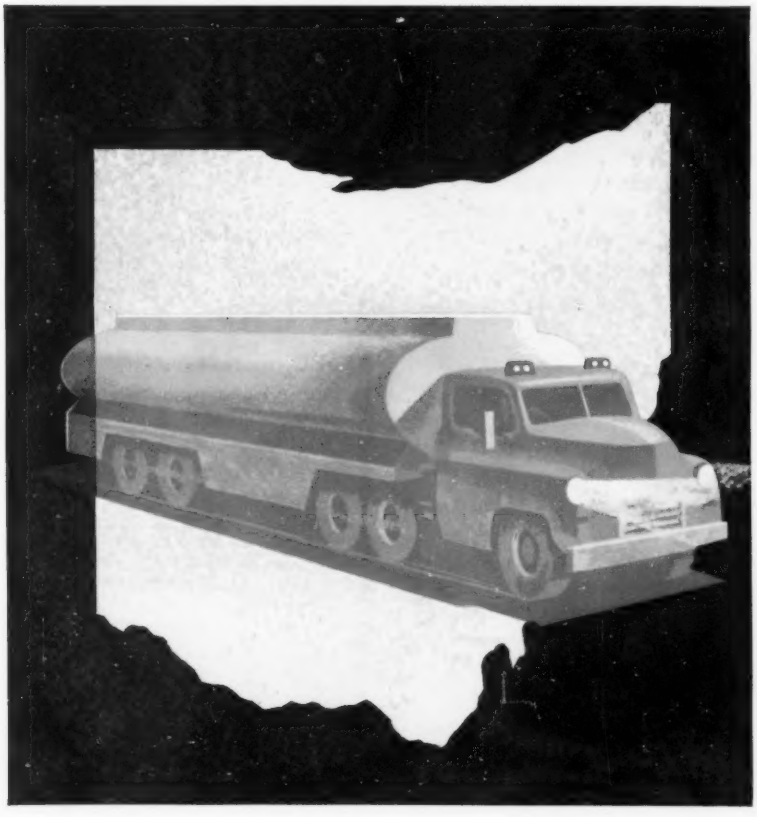
Four papers have been offered for the ASTM-NLGI symposium on the significance of oil viscosity in grease. In addition, there have been offers of discussion of the question of inclusion of oil viscosity requirements in grease specifications. The meeting will be held at the NLGI annual meeting in Houston.

Respectfully submitted,
L. C. Brunstrum
Chairman

Report of Subsection G-II-2 June 27, 1961

Subsection 2—Section II on "Dropping Point of Lubricating Greases" met on June 27 with thirty in attendance.

Results of dropping point tests on nine cooperative greases were



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reviewed. Tests were run by the following procedures:

Procedure A—Preheated Bath Method: The temperature of the bath was stabilized about 30°F above the expected dropping points of the various greases. The dropping point equipment assembled as prescribed by D 566-42 was then placed in the bath. The temperature at which the first drop of material fell from the cup was reported as the dropping point.

The times required for determination of dropping point by this method ranged from about two to eight minutes.

Procedure B: The dropping point equipment assembled as prescribed by D 566-42 was placed in the bath cooled to room temperature. The temperature of the bath was then raised at a rate similar to that prescribed by D 566. Dropping points were observed and reported as under "Procedure A."

By this procedure, times for determination of the dropping points of the various samples ranged from 35 to about 60 minutes.

In general, the data showed:

1. Poor precision by both procedures but somewhat better precision by Procedure B.

2. Based on the grand averages, dropping points of seven of the nine samples, determined by the two procedures were very similar. This indicated that the heating rate may not be too critical.

3. The various types (liquid, salt, air, aluminum block) of baths used could have affected the precision, particularly by Procedure A.

The discussion following the summary of cooperative test results suggested two approaches: (a) accept the precision limits shown by cooperative tests, publish for information and/or amend the precision limits of D 566-42; or (b) standardize on a specific type of bath and attempt to improve precision in a third series of cooperative tests. In this connection, a number of the people present seemed to prefer "Procedure A" since a considerable saving in operator time is possible. The elimination of liquid-type baths for high temperature use also seemed preferable.

Since no definite conclusion could be reached as to which of the above approaches should be taken, it was recommended that the question be referred to the Advisory Section for a decision. A subgroup comprised of Messrs. L. C. Brunstrum, J. L. Dreher, and P. L. Latour was tentatively appointed to investigate the type of bath most suitable for this application.

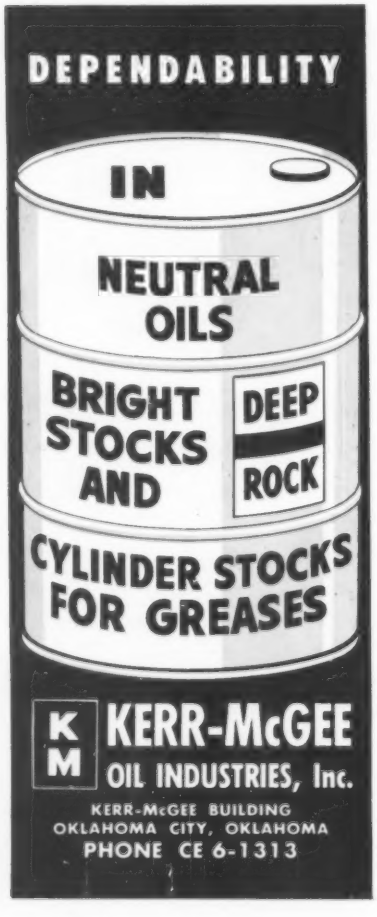
The Advisory Section recommended that the approach listed under (b) be followed and that the subgroup follow through on their assignment.

Respectfully submitted,
P. R. McCarthy, Chairman

Report of Section G-IV June 27, 1961

Section IV held a meeting on June 9, 1961, in Los Angeles with eight members present. This was the third meeting under our present assignment, which is to investigate the factors involved and to recommend a method of test for determining the temperature at which high temperature greases change from a semisolid to a liquid. Such a test is needed mainly for use with grease having ASTM dropping points of over 400°F to eliminate the discrepancy caused by oil separation during the conventional dropping point test.

One laboratory reported good repeatability with the four cooperative test greases using a calibrated aluminum bar which is heated at one end by a flame. This instrument is commonly used to determine the melting point of crystals. The semisolid to liquid temperature observations were within 4°F of the ASTM dropping point for each grease. The primary advantage of this technique is the short time required, which is about five minutes for each test. Also, commercial equipment of this type is available. One disadvantage is that the results are based upon visual observations with no change in consistency data actually being measured.



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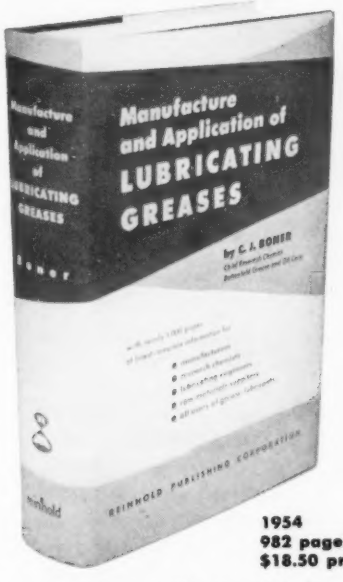

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Another laboratory reported results obtained using the Ultra Viscoson which is a long thin probe that vibrates at an ultrasonic rate. The probe is dampened by the test fluid, and the amount of dampening indicates the fluid viscosity. However, the presence of moisture and possibly some glycerine, together with oil separation, caused such erratic results that it is no longer considered promising.

A third laboratory reported on tests conducted with a modified S.O.D. Pressure Viscometer. The pressures required to pump the grease through a small capillary over a range of temperatures were determined. The grease was heated by means of a heated block in the line preceding the capillary. Pressure decreases were noted with increase in temperature, but no sudden decrease occurred as one would expect upon reaching the fluid point. Apparently, the shear rate used was too high to indicate such a change. The use of a low rate of shear should prove more promising.

Two laboratories conducted further tests with modifications of the Brookfield Viscometer. Good heat transfer was found to be of major importance. Improved results were obtained through the use of small samples and small sample containers approximately 1¼ inches in diameter. The repeatability was good and the apparent viscosity changes noted with increase in temperature appeared to coincide with the phase changes typical of the soap base greases. A sharp drop in apparent viscosity occurred in the general region of the ASTM dropping point of the soap base greases. In contrast, only a slight decrease in apparent viscosity was observed with a Bentone thickened grease, indicating that no liquifaction occurred.

The Brookfield Engineering Laboratories were contacted to obtain their recommendations concerning optimum conditions for the Brookfield Viscometer in the type of test being investigated. They confirmed our approach but suggested the use of a still smaller sample and a smaller Brookfield spindle. This will be investigated. As the Brookfield Viscometer appears to be the most promising instrument examined to date, other members of Section IV will join in this study.

Respectfully submitted,
HAROLD A. WOODS, Chairman

Report of Technical Committee B On Automotive Lubricants

Chairman, T. H. Risk; Vice-Chairman, T. B. Rendel; Secretary, H. A. Toulmin.

Technical Committee B met on Wednesday, June 28, 1961, in Atlantic City. Thirty members and guests were present.

The Advisory Committee met and formulated plans to immediately staff the four subcommittees covering:

1. Engine Lubricating Oils under C. M. Heinen.
2. Automatic Transmission Fluids under H. A. Hunstad.
3. Axle Oils under W. F. Ford.
4. Chassis Lubricants under L. A. McReynolds.

These subcommittees will report to Technical Committee B in October giving a report on their organization and future plans.

It was also agreed that as soon as possible all applicable test methods would be prepared for publication especially those on the five engine test sequences developed by Section G-IV.

It was also agreed that a one-day symposium on Automotive Lubricant Requirements in Full Scale Equipment be planned for the Los Angeles meeting in 1962.

Respectfully submitted,
T. H. RISK, Chairman
H. A. TOULMIN, Secretary

Lucidol Opens New Laboratory

The Lucidol Division of Wallace & Tiernan Inc. opened its new Research Center at Buffalo, N.Y. with appropriate ceremonies in October.

The building houses five laboratory sections, including analytical research, applications research, new products research, product and process development, technical service and quality control. The center also contains an extensive library, conference rooms, private offices, shower, locker and lunch rooms for personnel. All rooms are attractively decorated and many feature paintings by prominent artists on loan through the courtesy of the Members Gallery of the Albright-Knox Art Gallery.

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MoS_2 as a solid-film dry lubricant has been the subject of several articles. One details high-temperature properties; another describes a new bearing design that can increase bearing life as much as 450%.

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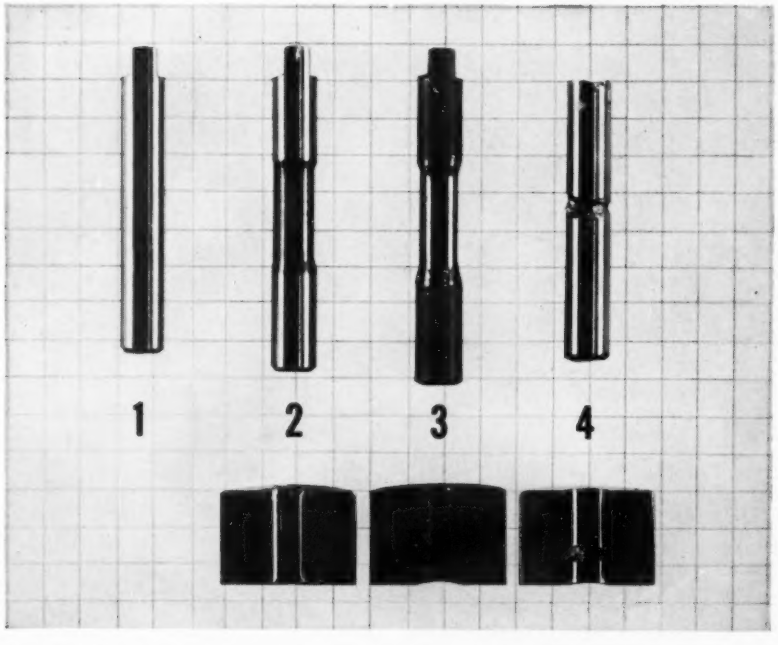
When writing, refer to CL-116

Proof of MoS_2's High-Pressure Properties



Photograph above shows mild steel test pins. No. 1: Unused pin, No. 2 (lubricated with mineral oil and Molysulfide) and No. 3 (with Molysulfide bonded coating) were subjected to rotating pressures between bearing halves. Both were elongated and extruded without galling, seizing, or weight loss. No. 4 shows typical failure with conventional lubricant. Note that the key sheared off and pin and block were galled and seized.

When writing, refer to CL-118

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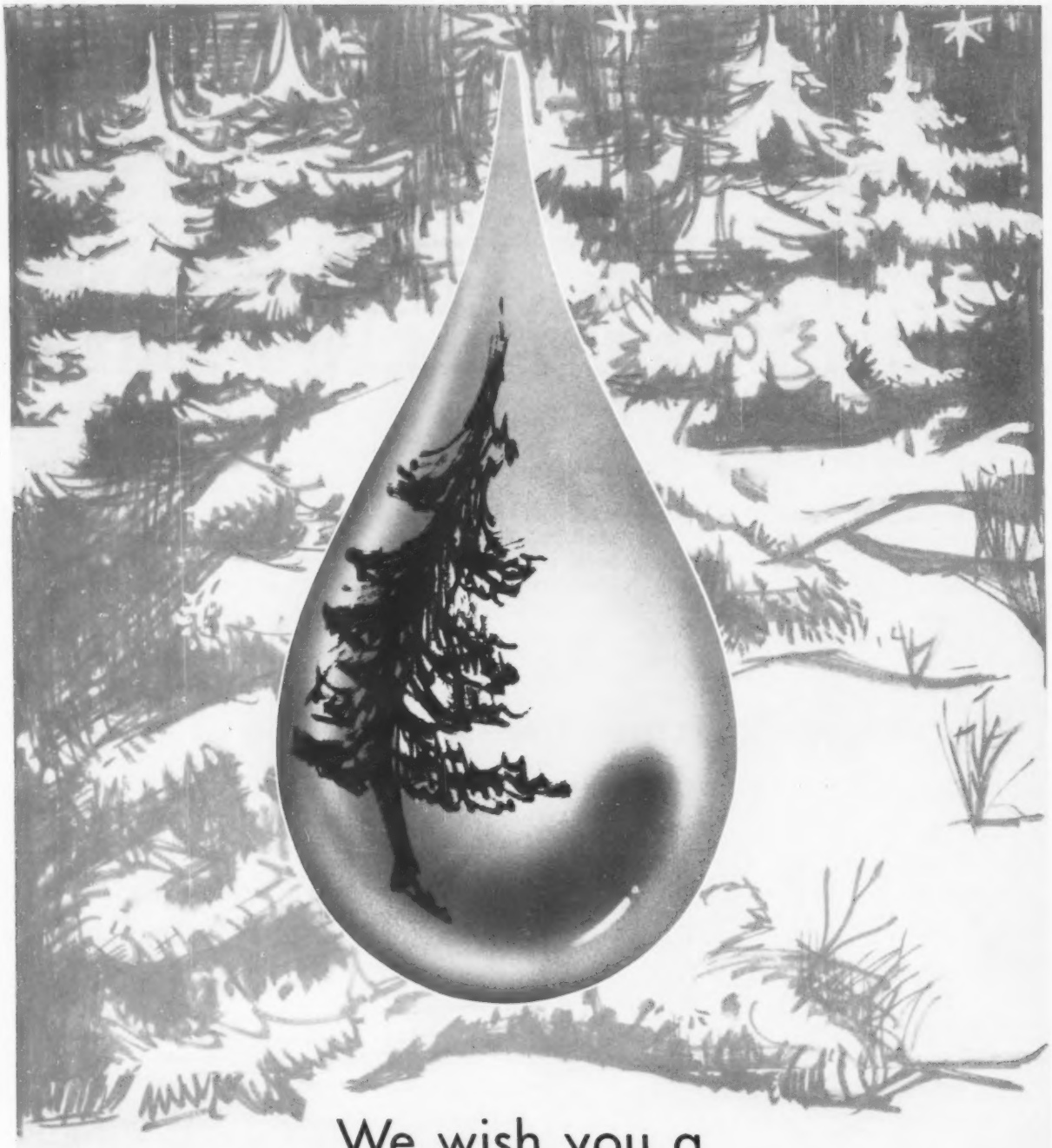

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